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ELECTRICAL AND DIELECTRIC PROPERTIES OF FOOD MATERIALS

Bibliography and Tabulated Data
Compiled by

M. KENT

A COST90bis Publication

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D. Vidal and Andree Voilley

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Liquid Properties of Foods

B. McKenna

In Preparation

SERIES EDITOR

Professor Ronald Jowitt, COST90bis Project Leader;
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*A Bibliography and Tabulated Data
Compiled by*

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**SCIENCE AND TECHNOLOGY PUBLISHERS
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FOREWORD

This Bibliography is one of several produced as a result of collaboration under COST90bis, the second European Project on the Physical Properties of Foods.

The objectives of COST90bis and its predecessor, COST90, were: more reliable, more accessible, more useful — or just simply, *more* information on the physical properties of food materials, in particular, more precise and accurate quantitative data.

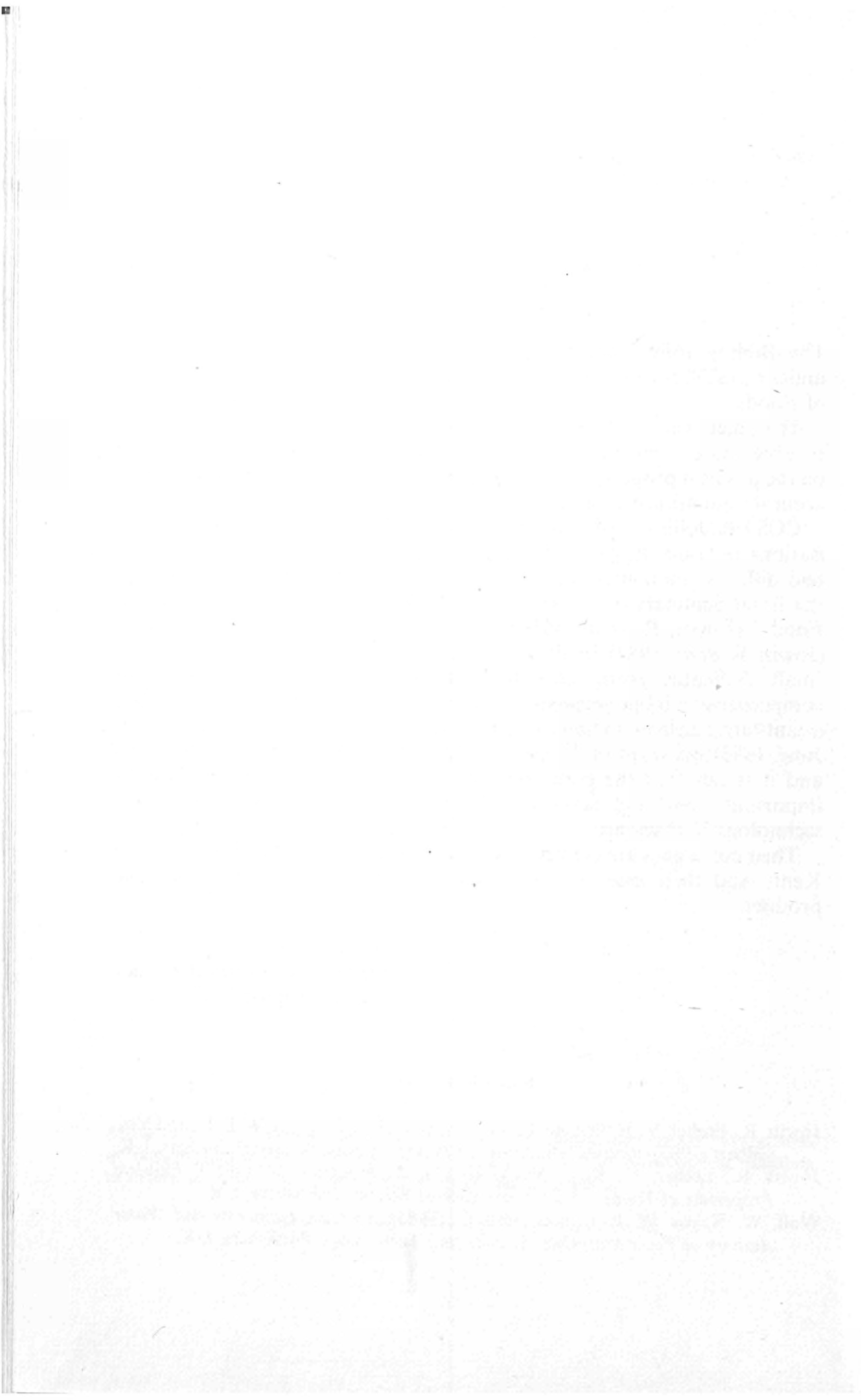
COST90/90bis coordinated the efforts of many individuals and organisations in some 15 participating states, which took various forms and had different outcomes. These are fully described in the Proceedings of the Final Seminars of COST90 and COST90bis, "Physical Properties of Foods" (Jowitt, R. *et al.*, 1983) and "Physical Properties of Foods—2" (Jowitt, R. *et al.*, 1987). In all the subject groups of COST90bis, however, a small, dedicated group of individuals undertook to produce at least comprehensive bibliographies on their subject along with, where feasible, quantitative data extracted from that literature. The first (Wolf, Spiess and Jung, 1985), on Sorption Properties of Foods, was well received by readers and it is felt that the complete collection of bibliographies will fill an important need and serve a valuable function in food engineering, technology and science.

Their colleagues are greatly indebted to the compilers—in this case Mike Kent—and their associates for their painstaking work and invaluable product.

Ronald Jowitt
COST90/90bis Project Leader
London, August 1987

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INTRODUCTION

Not since Adam (1969) has an attempt been made to bring together references on electrical and dielectric properties of foodstuffs in a publication such as this. Since then substantially more has been published, much of it not readily available to those who need or wish to know about it. It is therefore time for a new collection to appear and it is appropriate that it should do so under the auspices of COST90bis.

In compiling this bibliography papers were assessed from complete copies or abstracts and only references containing quantitative electrical or dielectric data have been included; many publications on the subject describing techniques but containing no data have thus been excluded.

Certain references included are themselves reviews or bibliographies containing mainly previously published values. Some of the data quoted in them, however, are without reference to any other publication and appear to originate in the review concerned. Nevertheless, it is felt that they should be included in a bibliography such as this.

This bibliography was compiled as part of the collaborative work of COST90bis in the field of electrical and optical properties of foodstuffs. (COST stands for European Cooperation in Scientific and Technological and Research, subjects concerned with Food being designated by the first digit '9' physical properties—the first project in the food field by the second digit '0').

COST90bis, the second such project on the physical properties of foods was concerned with electrical and optical properties, mechanical properties and diffusion properties.

In section (1) the references are arranged in alphabetical order of first author's names and numbered sequentially. Section (2) then classifies them by number under various subject heads, notably food substances. Section (3) then groups the references by number into four measurement frequency ranges felt to be most convenient for readers. Finally, electrical and dielectric data on specific food materials from the publications listed are tabulated in Section 4.

The contributions of members of the COST subgroup dealing with electrical properties are hereby acknowledged and individual thanks go to the following:

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and finally

- K. Parkin (néé Thomas), K. Maitland and A. Wood who performed the arduous task of typing many of these references into STATUS, the database of the UK Ministry of Agriculture, Fisheries and Food.

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Section 1

BIBLIOGRAPHY, ARRANGED ALPHABETICALLY ACCORDING TO FIRST AUTHOR'S NAME IN CHRONOLOGICAL ORDER; NUMBERED CONSECUTIVELY

The letters in the right-hand margin refer to the language in which the original reference was published.

C—Czech
E—English
F—French
G—German
R—Russian
Rum—Rumanian
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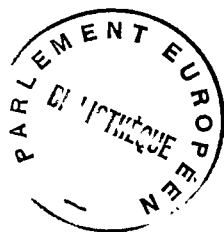
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Section 2

BIBLIOGRAPHY REFERENCE NUMBERS CLASSIFIED ACCORDING TO FOOD MATERIAL

1	Agricultural products *	3	7	22	32	33	35	39	40	51
		68	83	97	100	101	104	111	113	114
		115	125	130	131	132	133	134	135	136
		137	138	139	140	141	142	143	144	145
		146	147	148	149	150	151	152	155	207
		209	220	232	246					
2	Alfalfa *	135	136	140	220	232				
3	Apples *	2	22	36	41	104	127	132	134	145
		146	157	209	231	232	236	247	248	
4	Apple juice *	2	17							
5	Arabinose	38								
6	Aubergine (egg plant)	131	232							
7	Bacon *	232								
8	Bagasse	172								
9	Banana *	4								
10	Barley *	130	131	232						
11	Beans	131	232							
12	Beef *	14	15	16	29	41	57	58	64	65
		66	70	102	118	123	125	126	127	132
		134	158	159	160	199	205	215	216	230
		232	235	238	239	243	260			
13	Biscuits	96								
14	Bread and dough *	21	41							
15	Breadcrumbs *	41	232							
16	Bream (<i>Abramis brama</i>)	55								
17	Butter *	2	10	11	48	49	54	62	63	92
		93	105	116	117	132	134	156	174	175
		176	191	192	193	218	228	232	248	250
		252	253	254	255	256				
18	Cabbage *	14	67	131	232					
19	Canteloupe	132	145	146						
20	Carp (<i>Cyprinus carpio</i>)	107								
21	Carrots *	2	15	16	17	40	126	127	134	145
		146	160	209	232	236				
22	Cassava	3								
23	Castor oil *	18	173	221						

* Products for which data are also tabulated

24	Cheese	69	95	190	196	203				
25	Chicken *	91	123							
26	Chocolate	19								
27	Citrus juice	69	197							
28	Coconut oil *	18	173							
29	Cod * (<i>Gadus morhua</i>)	2 88	14 127	15 132	16 134	29 213	80 232	81	82	87
30	Coffee *	5	89	90	99	111				
31	Corn *	89 142	131 144	132 150	134 207	135 220	137 232	139	140	141
32	Corn oil *	170								
33	Cottonseed oil *	170								
34	Cream	9								
35	Crucian (<i>Cavassius cavossius</i>)	56								
36	Cucumber	232								
37	Curd	190								
38	Dairy products	2 48 76 110 134 176 192 211 242	8 49 77 111 156 179 193 212 248	9 50 90 116 164 180 194 218 250	10 54 92 117 165 181 196 228 251	11 62 93 119 166 182 200 229 252	23 63 95 120 167 183 202 232 253	41 71 99 121 168 184 203 233 254	43 72 105 127 174 190 204 234 255	47 73 106 132 175 191 210 235 256
39	Eggs	2	38	41	54	134	203	232		
40	Fats and oils *	4 65 173	13 66 187	15 105 213	16 128 221	17 129 232	18 132 245	41 134 258	52 169	59 170
41	Fish	2 83 212	12 85 230	14 86 232	29 87 240	41 88	56 107	80 158	81 187	82 208
42	Fishmeal *	60	78	79	84	111	232			
43	Flour *	26 207	27 232	30	31	41	60	113	148	149
44	Fruit	2 66 157	3 83 160	4 104 209	5 109 231	17 127 232	22 132 236	36 134	41 145	65 146

* Products for which data are also tabulated

45	Galactose	38	186						
46	Garlic	259							
47	Gels	45							
48	Glucose (dextrose) *	1	38	53	90	108	224	227	
49	Grain	5	28	32	33	34	74	89	100
		113	130	131	132	133	134	135	136
		138	139	140	141	142	143	144	148
		150	206	207	220	225	232	241	149
50	Grape juice	17							
51	Gravy	15	16	158	160	232			
52	Groundnut oil	245							
53	Haddock * (<i>Melanogrammus aeglefinus</i>)	80	81	83	85	87			
54	Ham *	15	16	24	67	125	126	127	160
55	Herring * (<i>Clupea harengus</i>)	14	41	232					232
56	Honey	153	244						
57	Lactose	19	38						
58	Lard *	232							
59	Legume seeds	7	170						
60	Lettuce	232							
61	Lemon sole * (<i>Microstomus kitt</i>)	87							
62	Lime juice	197							
63	Linseed oil *	18	221	245					
64	Liver (pork)	15	16	160	231	232			
65	Liver (beef)	70							
66	Mackerel (<i>Scomber scombrus</i>)	88							
67	Maltose *	1	224						
68	Maize (corn) *	206	207						
69	Mannose	38							
70	Margarine	111							

* Products for which data are also tabulated

71	Meat	5 55 125 195 230	6 57 126 198 232	14 58 127 199 235	15 64 132 201 237	16 65 154 205 239	24 70 158 214 240	29 91 159 215 243	41 118 160 216 260	46 123 185 226
72	Meat broth	15	25	91						
73	Milk *	16 73 132 181 204	23 76 134 182 210	39 77 164 183 211	41 106 165 184 212	43 110 166 190 229	47 119 167 194 232	48 120 168 196 233	71 121 179 200 234	72 127 180 202 242
74	Milk (dried)	23	41	77	89	90	99	111	232	235
75	Millet *	60	101	131	232					
76	Molasses	75	103							
77	Must	37								
78	Mustard oil *	245								
79	Oats *	60	131	135	136	140	220	232		
80	Okra	132	232							
81	Olive oil *	18	173	208						
82	Onion	203	232							
83	Orange juice	160	197							
84	Parsley	203								
85	Peaches *	65 236	66	109	132	134	145	146	209	232
86	Pears *	3	65	66	134	232	236			
87	Peas *	15 249	16	60	65	66	83	134	160	232
88	Pea flour	249								
89	Peanuts	131	132	134	232					
90	Peanut butter	160								
91	Pecans *	147								
92	Pepper	131	203	232						
93	Pineapple	160								
94	Pizza	118	160							
95	Pork *	6 123 217	15 126 226	16 127 230	24 132 232	64 134	65 160	66 185	91 215	118 216

* Products for which data are also tabulated

96	Potatoes *	4 67 134 223	16 68 145 232	17 90 146 236	22 124 158 237	35 125 160	39 126 169	41 127 171	65 128 195	66 132 209
97	Potato chips (crisps) *	169	171	232						
98	Potato chips * (French fried)	17	134	160						
99	Quarg	196								
100	Rabbit	91								
101	Rapeseed	114	115	155						
102	Rapeseed oil	18								
103	Ribose *	38	224							
104	Rice	94	122	187	232					
105	Roe (fish)	187								
106	Rye (grain)	32	35	232						
107	Sausage	64								
108	Scampi tails (<i>Nephrops norvegicus</i>)	86								
109	Seeds *	5 232	7	101	114	115	131	135	136	139
110	Sesame oil *	18	173							
111	Sesame seeds	5								
112	Sorghum	131	135	136	140	220	232			
113	Soya flour	88								
114	Soybeans *	131	135	136	140	152	213	232		
115	Soybean salad oil *	170								
116	Spinach *	65	66	131	132	134	232			
117	Sprats * (<i>Sprattus sprattus</i>)	14	56	118	187	232				
118	Squash *	65	66	132	134	232				
119	Starch	1 198	39 227	42 232	61	94	112	162	163	189
120	Strawberries	83								
121	Strawberry juice	17								

* Products for which data are also tabulated

122	Sucrose *	38	51	90	108	111	198	227	232	
123	Sugar beet	41	51	131	132	220	232			
124	Sugars	19 103 232	20 108	38 161	41 177	44 178	53 188	71 198	75 224	98 227
125	Sunflower oil *	170								
126	Sweet potato	35	145	146						
127	Tea	196								
128	Tomato	160	232							
129	Turkey *	123	232							
130	Vegetables	2 84 133	14 87 145	15 98 146	16 114 160	17 116 209	40 126 232	51 127 235	60 131 236	67 132 259
131	Vegetable soup	15	40	83	232					
132	Wheat *	28 132 149	34 133 151	89 134 207	97 135 220	100 136 232	102 138	111 140	113 143	131 148
133	Whey	203	204	232						
134	Yoghurt	196								

* Products for which data are also tabulated

Section 3

BIBLIOGRAPHY REFERENCE NUMBERS CLASSIFIED INTO FOUR MEASUREMENT FREQUENCY RANGES

1 DC to 50 kHz	1	2	3	8	9	19	20	22	23	24
	25	27	30	31	32	33	36	37	38	40
	43	44	45	47	48	50	51	52	53	55
	56	57	58	60	61	62	63	64	68	69
	71	72	73	75	76	82	83	87	88	94
	95	98	104	105	106	107	108	109	110	129
	132	133	134	136	138	140	151	157	161	162
	164	165	173	174	175	176	177	178	179	180
	181	182	183	184	185	186	187	190	191	192
	193	194	197	200	201	202	205	209	213	214
	215	216	217	218	220	221	222	225	226	227
	229	231	232	234	237	242	245	246	252	258
	259	260								
2 50 kHz to 1MHz	1	2	5	6	9	26	27	35	40	41
	42	46	54	57	58	59	60	61	63	70
	82	83	100	114	116	117	130	132	133	134
	136	138	140	141	147	151	163	166	184	188
	189	190	207	208	209	218	222	228	230	231
	232	246	251	252	260					
3 1MHz to 500MHz	1	2	5	6	7	9	10	11	14	17
	21	26	27	29	40	41	42	46	49	54
	57	59	61	63	67	70	77	80	82	83
	91	92	93	96	100	101	102	103	105	111
	114	115	120	122	127	130	131	132	133	134
	136	138	139	140	141	142	143	144	147	150
	151	152	153	155	156	158	160	163	167	168
	169	170	171	172	185	187	189	200	195	196
	198	207	208	209	216	218	219	222	224	230
	231	232	235	237	239	240	247	248	250	251
	253	254	255	256	257					
4 500MHz to 20GHz	1	2	4	7	12	13	15	16	17	28
	29	34	39	61	65	66	77	78	79	80
	81	82	83	84	85	86	89	90	97	99
	102	111	112	113	114	118	119	120	121	122
	123	124	125	126	127	128	132	133	134	135
	136	137	138	139	140	141	142	143	144	145
	146	147	148	149	150	151	152	153	158	159
	160	169	170	171	195	196	198	199	203	204
	210	211	212	222	223	224	231	232	233	235
	236	238	239	243	245	247	248	249		

Section 4

ELECTRICAL AND DIELECTRIC DATA SELECTED FROM THE BIBLIOGRAPHY

The data tabulated in this section have been taken from selected references within the bibliography and refer to the food materials indicated * in Section 2.

The data are presented as real and imaginary parts of the complex permittivity, ϵ' and ϵ'' respectively, at decade frequency intervals. In some instances dc specific conductivity is shown.

The original form of these data was either numerical in tables or graphical as plots of ϵ' and ϵ'' versus frequency with some parameter such as temperature or moisture content indicated. In the latter case the data have of necessity been read from the published curves and are therefore subject to any potential errors due to the difficulties inherent in this. Such errors may also be exacerbated by the need in some cases to calculate ϵ'' from given values of $\tan \sigma$ (the ratio of ϵ''/ϵ') or σ , the conductivity at the frequency of measurement. These points are made in order that authors of some of the references do not dispute the figures given as being at variance with their own original results. Such differences, it is believed, should be small and unimportant.

A further point concerns the selection of data for these tables. In general the data included are considered representative. In some cases there exist many published data on certain products but only those amenable to inclusion in these tables have been selected. For example, results may have been quoted in terms of specific instrument readings only and these have been ignored. Further, where one author has published data over a wide frequency range then that data has been selected in preference to data published for one frequency only.

Similarly the effects of variables such as the bulk density of powders or the degree of dispersion of water in butter have been ignored and only a selection included of the data from a particular work.

The tables are not meant to be exhaustive or comprehensive but rather to give a broad feel for the magnitude of the dielectric properties of foodstuffs. If anything, they show how much more remains to be done in relation to the measurement of these properties of foodstuffs.

Finally, Tinga and Nelson²³² have published a much more general table of dielectric properties of materials including foodstuffs. That table and bibliography, whilst more general in coverage, is also more restricted in its sources of data. If available it may be used in conjunction with this work since to a certain extent they complement each other but as a bibliography this present work is the more complete.

TABLES CONTAINING DIELECTRIC DATA FOR FOOD AND AGRICULTURAL MATERIALS

Table 1 Agricultural Products

Alfalfa	Oats
Barley	Pecans
Coffee beans	Sesame seeds
Maize (corn)	Soybeans
Millet	Wheat

Table 2 Bakery Products

Bread	Flour
Breadcrumbs	

Table 3 Dairy Products

Butter	Skim milk
Milk concentrates	Milk powders

Table 4 Fish

Cod	Herring
Fishmeal	Lemon sole
Haddock	Sprats

Table 5 Fruit

Apple	Peach
Apple juice	Pear
Banana	

Table 6 Meat

Beef	Pork
Chicken	Turkey
Ham	

Table 7 Oils and Fats

Bacon fat	Linseed oil
Beef fat	Mustard oil
Castor oil	Olive oil
Coconut oil	Pork fat
Corn oil	Sesame oil
Cottonseed oil	Soybean salad oil
Ham fat	Sunflower oil
Lard	

Table 8 Sugars

Glucose	Ribose
Maltose	Sucrose

Table 9 Vegetables

Cabbage	Potato chips (crisps)
Carrot	Spinach
Peas	Squash
Potato	

Table 1

Agricultural Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Alfalfa	24	ε'			4.8	4.0	3.7
		ε''			2.0	0.46	0.21
	24	ε'		3.85 ^a	3.85	3.53	
		ε''		0.56	0.33	0.1	
		ε'		5.64 ^a	4.49	3.85	
		ε''		3.33	1.44	0.33	
		ε'		10.26 ^a	5.77	4.49	
		ε''		5.89	3.58	0.89	
		ε'		17.50 ^a	16.0	9.29	
		ε''		6.78	4.11	4.89	
Barley	21	ε'					
		ε''					
		ε'					
		ε''					
	24	ε'					
		ε''					
		ε'					
		ε''					
Coffee beans	21	ε'					
		ε''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
3.5	3.3	2.9	2.5	2.3	Ref 136
0.17	0.25	0.25	0.21	0.13	mc = 7.5%
					Ref 224 (a) 250 Hz mc = 5.5%
					mc = 6.8%
					mc = 7.8%
					mc = 10.7%
				2.3 ^a	Ref 97 natural density (a) 9.4×10^9 Hz mc = 12%
				0.16	
				2.65 ^a	mc = 18%
				0.39	
3.0	2.9	2.8 ^a			Ref 131 (a) 0.5×10^8 Hz mc = 9.2%
0.15	0.25	0.38			
3.9	3.4	3.25 ^a			mc = 15.2%
0.56	0.35	0.44			
5.05	4.7	3.8 ^a			mc = 20.0%
1.35	0.70	0.53			
2.0	2.0				Ref 5
0.17	0.07				mc = 8.0%

Table 1 (contd)

Agricultural Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Coffee beans (contd)	180	ε'					
		ε''					
	50	ε'					
		ε''					
	100	ε'					
		ε''					
	150	ε'					
		ε''					
	170	ε'					
		ε''					
Maize (corn)	20	ε'					3.18
		ε''					
		ε'					5.58
		ε''					
		ε'					10.21
		ε''					
	24	ε'					
		ε''					
		ε'					
		ε''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
2.4	2.0				Ref 5 (contd) mc = 1.2% (a) 2×10^7 Hz Ref 5 (a) 2×10^7 Hz
0.09	0.1				
	2.0 ^a 0.14				
	2.7 ^a 0.37				
	2.5 ^a 0.32				
	2.0 ^a 0.15				Ref 207 (a) 2×10^5 Hz (b) 2×10^6 Hz (c) 2×10^7 Hz mc = 10% mc = 20% mc = 30%
2.95 ^b	2.74 ^c				
4.63 ^b	3.79 ^c				
6.53 ^b	4.84 ^c				
4.02	3.62	3.21	2.41	2.10	Ref 141 mc = 10% mc = 20% mc = 30%
0.25	0.41	0.41	0	0.2	
7.07	5.44	4.63	3.01	2.60	
1.73	0.82	0.62	0.1	0.3	
10.7	7.28	5.45	3.54	3.0	
5.76	2.06	1.03	0.2	0.5	

Table 1 (contd)

Agricultural Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Maize (corn) (contd)	24	ϵ'					
		ϵ''					
	24	ϵ'		4.6 ^a	4.1	3.8	
		ϵ''		1.05	0.61	0.21	
		ϵ'		5.6 ^a	4.8	4.1	
		ϵ''		1.75	1.14	0.48	
		ϵ'		12.0 ^a	7.6	5.1	
		ϵ''		4.30	3.62	1.52	
		ϵ'		15.7 ^a	11.9	9.9	
		ϵ''		6.15	5.07	3.0	
	21	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
Millet		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
15.8	9.51	6.67	4.64	4.0	Ref 141 (contd)
13.2	5.35	1.85	0.41	0.6	mc = 40%
					Ref 220 (a) 250 Hz mc = 8.8%
					mc = 10.1%
					mc = 12.0%
					Ref 220 mc = 14.2%
				2.6 ^a	Ref 97 natural density (a) 0.94 x 10 ⁻¹⁰ Hz mc = 12%
				0.28	
				3.02 ^a	mc = 18%
				0.63	
	3.28				Ref 101
	0.08				mc = 8%
	3.83				mc = 11%
	0.108				
	4.79				mc = 14.5%
	0.135				
	6.72				mc = 21%
	0.196				

Table 1 (contd)

Agricultural Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Millet (contd)	21	ε'			1.4	1.15	
		ε''			0	0.01	
Oats	24	ε'		2.90 ^a	2.90	2.71	
		ε''		0.48	0.29	0.079	
		ε'		4.52 ^a	3.87	3.23	
		ε''		2.14	1.11	0.25	
		ε'		10.65 ^a	7.10	4.19	
		ε''		4.29	3.89	1.03	
		ε'		15.81 ^a	13.55	7.23	
		ε''		2.14	3.89	3.02	
		ε'		18.70 ^a	17.10	11.16	
		ε''		2.86	3.33	4.29	
	24	ε'		7.32 ^a	5.05	3.51	2.91
		ε''		3.79	2.06	0.74	0.21
	21	ε'			5.0	4.4	
		ε''			0.016	0.079	
Pecans (chopped)	22	ε'					2.31
		ε''					0.61
		ε'					5.41
		ε''					2.31
		ε'					7.11
		ε''					3.01

f(Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
					Ref 60 mc = 24.8%
					Ref 220 (a) 250 Hz mc = 7.7%
					mc = 9.5%
					mc = 11.1%
					mc = 12.6%
					mc = 14.0%
2.89 0.12	2.68 0.21	2.37 0.22	2.06 0.17	1.96 0.12	Ref 136 (a) 250 Hz mc = 10.7%
					Ref 60
2.05 0.244	2.01 0.168	1.94 0.139	1.77 0.100	1.71 0.066	Ref 147 mc = 3.6%
3.02 1.45	2.47 0.532	2.21 0.218	1.94 0.139	1.87 0.104	mc = 4.4%
4.70 2.10	3.02 1.08	2.51 0.353	2.21 0.226	1.98 0.181	mc = 6.5%

Table 1 (contd)

Agricultural Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Pecans (chopped) (contd)	22	ε'					8.4
		ε''					4.1
Sesame seeds	20	ε'					
		ε''					
	40	ε'					
		ε''					
	80	ε'					
		ε''					
	120	ε'					
		ε''					
	160	ε'					
		ε''					
Soybeans	24	ε'		3.05 ^a	2.85	2.58	
		ε''		0.62	0.39	0.12	
		ε'		7.5 ^a	5.2	3.7	
		ε''		4.2	3.0	0.16	
	24	ε'		12.2 ^a	10.5	6.5	
		ε''		2.6	3.5	3.0	
		ε'		14.8 ^a	13.1	9.6	
		ε''		4.8	3.5	3.3	
	24	ε'		7.0 ^a	4.95	3.40	3.2
		ε''		3.92	2.39	0.78	0.3

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
5.25	3.37	2.70	2.33	2.05	Ref 147 (contd)
2.73	1.50	0.595	0.262	0.195	mc = 8.6%
500	100				Ref 5
40	10				mc = 24%
900	110				mc = 24%
2.0	2.0				
0.015	0.03				mc = 0.7%
2.15	2.1				
0.05	0.05				
2.50	2.30				
0.33	0.08				
					Ref 220 (a) 250 Hz mc = 6.1%
					mc = 8.5%
					Ref 213 (a) 25 Hz mc = 10.8%
					mc = 12.7%
3.05	2.89	2.68	2.58	2.47	Ref 136 (a) 250 Hz
0.29	0.25	0.19	0.12	0.12	mc = 8.5%

Table 1 (contd)

Agricultural Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Wheat	22	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
	25	ϵ'					
		ϵ''					
	24	ϵ'			4.12	4.12	4.12
		ϵ''			0.13	0.12	0.13
		ϵ'			27.0	15.6	9.15
		ϵ''			10.0	5.62	3.16
		ϵ'					
		ϵ''			365	100	13.3
	24	ϵ'		6.23 ^a	5.4	2.99	
		ϵ''		1.82	1.14	0.34	
		ϵ'		9.19 ^a	7.19	5.09	
		ϵ''		4.09	2.95	1.09	
		ϵ'		14.11 ^a	10.9	6.75	
		ϵ''		5.23	5.23	3.23	
		ϵ'		20.67 ^a	17.2	9.86	
		ϵ''		6.25	7.73	5.80	
	24	ϵ'		9.69 ^a	7.53	5.46	4.64
		ϵ''		2.89	2.31	0.91	0.33

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
				2.56 ^a 0.28	Ref 97 natural density (a) 9.4 x 10 ⁵ Hz mc = 12% <hr/>
				2.78 ^a 0.46	
	2.95 ^a 0.28	2.9 0.375	2.47 0.305		Ref 102 (a) 3 x 10 ⁷ Hz
3.46 0.21	3.16 0.32	2.89 0.24	2.42 0.13	2.03 0.10	Ref 138 mc = 6.0% <hr/> mc = 16.8% <hr/> mc = 23.8% <hr/>
5.38 1.15	4.92 0.562	4.51 0.365	3.78 0.299	2.89 0.274	
3.16	1.28	0.562	0.562	0.649	
					Ref 220 (a) 250 Hz mc = 10.0% <hr/> mc = 12.0% <hr/> mc = 14.0% <hr/> mc = 15.8% <hr/>
4.54 0.21	4.3 0.41	3.61 0.45	2.89 0.29	2.58 0.25	Ref 136 (a) 250 Hz mc = 12.5%

Table 2

Bakery Products

Product	T (°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Bread	20	ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
	30	ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
	40	ε'					
		ε''					

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
	1.88 0.099				Ref 21 dry basis mc = 7.05%
	2.36 0.232				mc = 18.15%
	2.82 0.270				mc = 23.95%
	4.21 0.887				mc = 32.70%
	18.19 12.83				mc = 66.2%
	1.91 0.101				mc = 7.05%
	2.41 0.238				mc = 18.15%
	2.89 0.278				mc = 23.95%
	4.32 0.926				mc = 32.70%
	18.31 13.09				mc = 66.20%
	1.97 0.104				mc = 7.05%

Table 2 (contd)

Bakery Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Bread (contd)	40	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
	60	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
Bread crumbs	0	ϵ'					3.3
		ϵ''					0.31
	70	ϵ'					6.3
		ϵ''					2.5

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
	2.47 0.246				Ref 21 (contd) mc = <u>18.15%</u> mc = <u>23.95%</u> mc = <u>32.70%</u> mc = <u>66.25%</u> mc = <u>7.05%</u> mc = <u>18.15%</u> mc = <u>23.95%</u> mc = <u>32.70%</u> mc = <u>66.2%</u>
	2.96 0.286				
	4.43 0.965				
	18.43 13.35				
	2.07 0.110				
	2.58 0.260				
	3.10 0.302				
	4.66 1.049				
	18.68 13.90				
2.9 ^b	2.3 ^c				Ref 41 (a) 2×10^5 Hz (b) 2×10^6 Hz (c) 2×10^7 Hz
0.26	0.20				
5.0 ^b	3.7 ^c				
0.90	0.52				

Table 2 (contd)

Bakery Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Bread crumbs (contd)	100	ϵ'					
		ϵ''					
Flour	-20	ϵ'					2.8
		ϵ''					0.162
		ϵ'					4.1
		ϵ''					0.308
		ϵ'					5.0
		ϵ''					0.385
	0	ϵ'					3.2
		ϵ''					0.170
		ϵ'					4.4
		ϵ''					0.242
		ϵ'					5.6
		ϵ''					0.403
	20	ϵ'					5.3
		ϵ''					0.239
		ϵ'					4.8
		ϵ''					0.240
		ϵ'					6.0
		ϵ''					0.660
	40	ϵ'					3.7
		ϵ''					0.479

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
6.8 ^b	4.7 ^c				Ref 41 (contd) (b) 2×10^6 Hz (c) 2×10^7 Hz
2.18	0.94				
2.4 ^b	2.5 ^c				(a) 2×10^5 Hz (b) 2×10^6 Hz (c) 2×10^7 Hz mc = 3.2%
0.146	0.113				
3.8 ^b	3.0 ^c				mc = 9.0%
0.334	0.330				
4.6 ^b	3.9 ^c				mc = 14.4%
0.506	0.507				
2.8 ^b	2.8 ^c				mc = 3.2%
0.184	0.184				
4.1 ^b	3.5 ^c				mc = 9.0%
0.349	0.350				
5.0 ^b	4.5 ^c				mc = 14.4%
0.410	0.473				
3.1 ^b	2.7 ^c				mc = 3.2%
0.208	0.200				
4.4 ^b	4.0 ^c				mc = 9.0%
0.304	0.380				
5.2 ^b	5.0 ^c				mc = 14.4%
0.369	0.400				
3.5 ^b	2.7 ^c				mc = 3.2%
0.196	0.235				

Table 2 (contd)

Bakery Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Flour (contd)	40	ϵ'					5.0 ^a
		ϵ''					0.265
		ϵ'					7.0 ^a
		ϵ''					1.75
	70	ϵ'					4.2 ^a
		ϵ''					0.118
		ϵ'					5.7 ^a
		ϵ''					0.684
		ϵ'					10.0 ^a
		ϵ''					6.4
	100	ϵ'					4.2 ^a
		ϵ''					0.122
		ϵ'					7.4 ^a
		ϵ''					2.88
		ϵ'					
		ϵ''					
	22	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					

f(Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
4.8 ^b	4.6 ^c				Ref 41 (contd) (a) 2 x 10 ⁵ Hz (b) 2 x 10 ⁶ Hz (c) 2 x 10 ⁷ Hz mc = 9.0% <hr/> mc = 14.4% <hr/> mc = 3.2% <hr/> mc = 9.0% <hr/> mc = 14.4% <hr/> mc = 3.2% <hr/> mc = 9.0% <hr/> mc = 14.4%
0.264	0.405				
6.2 ^b	5.2 ^c				
0.806	0.520				
4.0 ^b	3.2 ^c				
0.160	0.275				
5.4 ^b	4.7 ^c				
0.335	0.353				
7.3 ^b	6.0 ^c				
1.75	0.72				
4.3 ^b	3.6 ^c				
0.129	0.238				
6.1 ^b	4.8 ^c				
0.794	0.456				
8.8 ^b	6.5 ^c				
4.58	1.3				
				4.12 ^a	Ref 149 average value, ¹⁰ Hz (a) 1.17 x 10 ¹⁰ Hz mc = 8.5% <hr/> mc = 10.0% <hr/> mc = 10.9%
				0.46	
				4.35 ^a	
				0.569	
				4.42 ^a	
				0.647	

Table 2 (contd)

Bakery Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Flour (contd)		ε'					
		ε''					
		ε'					
		ε''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
				4.58 ^a	Ref 149 (contd) mc = 12.2%
				0.812	
				5.11 ^a	mc = 14.7%
				1.22	

Table 3

Dairy Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Butter	15	ϵ'					
		ϵ''					
	15	ϵ'		4.9	4.7	4.7	4.6
		ϵ''		0.18	0.05	0	0
		ϵ'		5.19			
		ϵ''		0.18			
		ϵ'		5.43			
		ϵ''		0.20			
	15	ϵ'					
		ϵ''					
	10	ϵ'					
		ϵ''					
	5	ϵ'					
		ϵ''					
	0	ϵ'					
		ϵ''					
	-5	ϵ'					
		ϵ''					
	-10	ϵ'					
		ϵ''					
	-15	ϵ'					
		ϵ''					

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
	6-18 ^a				Ref 10 variation with degree of dispersion (a) 3×10^7 Hz
4.6 0.02	4.0 0.16				Ref 63 mc = 16.06% <hr/> mc = 18% <hr/> mc = 20%
4.56 0.01					
5.31 0.03					
5.12 ^a	5.08	4.31			
5.04 ^a	5.04	4.18			Ref 92 (a) 1.3×10^6 Hz
4.96 ^a	4.92	3.98			
4.88 ^a	4.79	3.77			
4.75 ^a	4.59	3.57			
4.59 ^a	4.39	3.39			
4.39 ^a	4.06	3.24			

Table 3 (contd)

Dairy Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Butter (contd)	-20	ε'					4.9 ^a
		ε''					0.196
	0	ε'					5.5 ^a
		ε''					0.094
	10	ε'					5.7 ^a
		ε''					0.171
	20	ε'					5.4 ^a
		ε''					0.027
	30	ε'					5.4 ^a
		ε''					0.016
	4	ε'					
		ε''					
		ε'					
		ε''					
	20	ε'					5.95 ^a
		ε''					
		ε'					6.42 ^a
		ε''					
		ε'					6.01 ^a
		ε''					
		ε'					6.08 ^a
		ε''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
4.7 ^b	4.4 ^c				Ref 41 (contd) (a) 2×10^5 Hz (b) 2×10^6 Hz (c) 2×10^7 Hz
0.183	0.189				
5.2 ^b	5.1 ^c				
0.172	0.275				
5.4 ^b	5.2 ^c				Ref 41 (a) 2×10^5 Hz (b) 2×10^6 Hz (c) 2×10^7 Hz
0.162	0.260				
5.4 ^b	5.1 ^c				
0.059	0.020				
5.2 ^b	5.1 ^c				Ref 156 (a) 1.5×10^7 Hz monthly average minimum in November maximum in April mc = 13.8 - 17.4% salt = 1.32 - 2.23
	5.8 ^a				
	0.54				
	8.7				
	2.33				Ref 257 (a) 2×10^5 Hz mc = 13.5% _____ mc = 15.2% _____ mc = 16.4% _____ mc = 18.8%
5.55	5.20				
5.90	5.80				
5.70	5.75				
5.90	6.15				

Table 3 (contd)

Dairy Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Milk Concentrates Whole Milk	10	ϵ'					
		ϵ''	0.55 ^a				
	30	ϵ'					
		ϵ''	0.90 ^a				
	50	ϵ'					
		ϵ''	1.25 ^a				
	70	ϵ'					
		ϵ''	1.65 ^a				
Skim milk	10	ϵ'					
		ϵ''	0.76 ^a				
	30	ϵ'					
		ϵ''	1.25 ^a				
	50	ϵ'					
		ϵ''	1.77 ^a				
	70	ϵ'					
		ϵ''	2.35 ^a				
Milk Powders (skimmed)	22	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
					Ref 48 20% total solids (a) dc conductivity $\sigma(\text{sm}^{-1})$
					Ref 48 20% total solids (a) dc conductivity $\sigma(\text{sm}^{-1})$
				1.74	Ref 99 p = 500 kg m ⁻³ mc = 4.0% _____
				0.032	
				1.80	
				0.049	
				1.88	mc = 7.5% _____
				0.073	
					mc = 9.6%

Table 3 (contd)

Dairy Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Milk Powders (skimmed) (contd) <							

f(Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
2.1 ^b 0.038	1.9 ^c 0.040				Ref 41 (a) 2 x 10 ⁵ Hz (b) 2 x 10 ⁶ Hz (c) 2 x 10 ⁷ Hz
2.1 ^b 0.038	1.9 ^c 0.046				
2.1 ^b 0.044	1.8 ^c 0.054				
2.4 ^b 0.067	2.0 ^c 0.072				
3.2 ^b 0.416	2.7 ^c 0.257				
2.3 ^b 0.039	2.1 ^c 0.050				
2.4 ^b 0.034	2.3 ^c 0.062				
2.4 ^b 0.036	2.2 ^c 0.057				
2.5 ^b 0.0400	2.3 ^c 0.055				
2.8 ^b 0.118	2.5 ^c 0.093				
			78.0 ^a 22.8		Ref 121

Table 3 (contd)

Dairy Products

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Milk (skimmed) (contd)	35	ε' ε''					
	45	ε' ε''					
	55	ε' ε''					
	0	ε' ε''					
	30	ε' ε''					
	50	ε' ε''					
	0	ε' ε''					
	30	ε' ε''					
	50	ε' ε''					

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
			74.5 22.0		Ref 121 (contd)
			70.0 25.6		
			67.2 29.4		
			70.1 ^a 25.9		
			66.3 ^a 15.2		Ref 211 (a) 3×10^9 Hz mc = 91%
			60.7 ^a 14.1		
			63.5 ^a 23.0		
			60.0 ^a 13.2		mc = 86.1%
			55.0 ^a 12.1		
					(a) 3×10^9 Hz

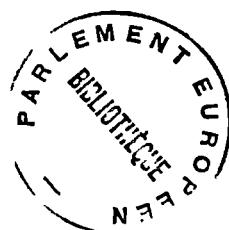


Table 4

Fish

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Cod (cooked)	20	ϵ' ϵ''					
	40	ϵ' ϵ''					
	60	ϵ' ϵ''					
	0	ϵ' ϵ''					
	-10	ϵ' ϵ''					
	-20	ϵ' ϵ''					
(raw)	2	ϵ' ϵ''					
	-10	ϵ' ϵ''					
(fresh)	-78.5	ϵ' ϵ''	84.0 ^a 28.0	70.0 20.0	40.0 26.0	8.0	
	2.7	ϵ' ϵ''					
	-8.0	ϵ' ϵ''					

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
			46.5 ^a 11.9		Ref 15 (a) 2.8 x 10 ⁹ Hz (b) 2.45 x 10 ⁹ Hz
			44.5 ^b 10.5		
			41.5 ^b 10		
			46.0 ^b 15.4		
			4.9 ^b 0.64		
			4.2 ^b 0.40		
	93.0 900	73.0 102			Ref 14
	12.5 18.8	7.5 3.8			
					Ref 87 (a) 25 Hz
	26.0 159	14.0 14.7			Ref 80
	13.0 23.4	9.5 6.1			

Table 4 (contd)

Fish

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Cod (fresh) (contd)	-20	ϵ'					
		ϵ''					
	-30	ϵ'					
		ϵ''					
Fishmeal	10	ϵ'					
		ϵ''					
	50	ϵ'					
		ϵ''					
	90	ϵ'					
		ϵ''					
	10	ϵ'					
		ϵ''					
	50	ϵ'					
		ϵ''					
	90	ϵ'					
		ϵ''					
	10	ϵ'					
		ϵ''					
	50	ϵ'					
		ϵ''					
	90	ϵ'					
		ϵ''					

f(Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
	6.5	4.3			Ref 80 (contd)
	2.6	1.1			
	4.4	3.8			
	1.0	0.61			
				2.06 0.018	Ref 79 ρ = 650 kg m ⁻³ mc = 2% <hr/> mc = 10% <hr/> mc = 16%
				2.08 0.028	
				2.11 0.038	
				2.14 0.058	
				2.32 0.112	
				2.55 0.21	
				2.43 0.148	
				2.66 0.298	
				3.02 0.452	

Table 4 (contd)

Fish

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Fishmeal (contd)	25	ε'			1.15 ^a	1.10 ^b	1.05 ^c
		ε''			0.0081	0.0094	0.010
		ε'			1.27 ^a	1.20 ^b	1.12 ^c
		ε''			0.0121	0.0128	0.0140
		ε'			1.35 ^a	1.28 ^b	1.15 ^c
		ε''			0.0151	0.0161	0.0168
Haddock (fresh)	-78.5	ε'	80.0 ^a	70.0	40.5		
		ε''	17.0	15.0	26.0		
Herring	2	ε'					
		ε''					
	-10	ε'					
		ε''					
	-20	ε'					^a
		ε''					233
	-10	ε'					^a
		ε''					809
	0	ε'					^a
		ε''					18000
Lemon Sole (fresh)	-78.5	ε'	86.0 ^a	43.0	39.0		
		ε''	27.0	20.0	28.0		
Sprats	2	ε'					
		ε''					

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
					Ref 60 mc = 9.5% ratio of granule length/diameter A = 1.8 (d)
					(a) 5 x 10 ³ Hz (b) 20 x 10 ³ Hz (c) 500 x 10 ³ Hz A = 1.0
					A = 0.4
					Ref 87 (a) 25 Hz
	88.5	66.9			Ref 14
	800	113			
	10	6.9			
	15.5	5.8			
b	c				Ref 41 (a) 2 x 10 ⁵ Hz (b) 2 x 10 ⁶ Hz (c) 2 x 10 ⁷ Hz
23.3	2.33				
b	c				
80.9	8.09				
b	c				
1800	180				
					Ref 87 (a) 25 Hz
	66.0 ^a	79.0			Ref 14 (a) 3.5 x 10 ⁷ Hz
	200	122			

Table 4 (contd)

Fish

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Sprats (contd)	-10	ε'					
		ε''					

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
	10.0 ^a	6.5			Ref 14 (contd)
	15.5	3.3			(a) 3.5×10^7 Hz

Table 5

Fruit

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Apple	19	ε'					
		ε''					
	25	ε'					
		ε''			4.4x10 ⁵	6.1x10 ⁴	1.8x10 ⁴
Apple juice		ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
Banana (mashed)	25	ε'					
		ε''					
	30	ε'					
		ε''					
	40	ε'					
		ε''					
	50	ε'					
		ε''					
	50	ε'					
		ε''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
		65.4 24.5	61.2 8.8	42.0 23.1	Ref 236
3.4×10^3	270	28.7			Ref 209
	9.0 ^a				Ref 17 (a) 2.7×10^6 Hz mc = 5.0% mc = 10% mc = 15% mc = 20%
	16.3 ^a				
	25.0 ^a				
	37.5 ^a				
			73.2 ^a 28.0		Ref 4 (a) 2.2×10^9 Hz Temperature increasing Temperature decreasing
			74 ^a 27.6		
			74.5 ^a 28.2		
			76.5 ^a 30		
			78.0 ^a 29.8		

Table 5 (contd)

Fruit

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Banana (mashed) (contd)	40	ε'					
		ε''					
	30	ε'					
		ε''					
Peach Peach (freeze dried)	25	ε'					
		ε''			9.3x10 ⁵	1.1x10 ⁵	2.3x10 ⁴
	20	ε'					
		ε''					
	-4	ε'					
		ε''					
	-7	ε'					
		ε''					
	-10	ε'					
		ε''					
	-15	ε'					
		ε''					
Pear Pear (freeze dried)	23	ε'					
		ε''					
	-4	ε'					
		ε''					
	-10	ε'					
		ε''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
			77.5 ^a 31.0		Ref 4 (contd) Temperature decreasing (a) 2.2×10^9 Hz
			78.0 ^a 34.5		
	790	79.1			Ref 209
		78.2 ~60	71.3 12.7	49.9 34.6	Ref 236
		9.70 ^a 3.42	7.48 3.0		Ref 66 (a) 5.0×10^8 Hz
		6.10 ^a 3.67	3.22 1.97		
		5.83 ^a 1.83	4.1 0.50		
		3.97 ^a 1.29	1.77 0.186		
	71.0 58.0	68.0 12.5			Ref 236
			13.6 4.56		Ref 69 (a) 0.9×10^9
			6.72 ^a 2.12		

Table 6

Meat

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Beef (raw)	-15	ϵ'					
		ϵ''					
(roasted)	23	ϵ'					
		ϵ''					
(raw)	-20	ϵ'					
		ϵ''					
(raw)	-40	ϵ'					
		ϵ''					
(raw)	-20	ϵ'					
		ϵ''					
(raw)	-10	ϵ'					
		ϵ''					
(raw)	0	ϵ'					
		ϵ''					
(raw)	20	ϵ'					
		ϵ''					
(raw)	40	ϵ'					
		ϵ''					
(raw)	60	ϵ'					
		ϵ''					
(raw)	10	ϵ'					
		ϵ''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
			5.0 0.75		Ref 118
			28 5.6		
		5.4 ^a 0.97	4.8 ^b 0.54	4.4 ^c 0.51	
		3.9 ^a 0.34	3.6 ^b 0.21	3.5 ^c 0.13	Ref 123 (a) 3×10^8 Hz ⁹ (b) 0.915×10^9 Hz (c) 0.245×10^{10} Hz
			4.8 ^a 0.57		Ref 15 (a) 2.8×10^9 Hz
			6.2 ^a 1.57		
			47.8 ^a 16.1		
			47.7 ^a 13.4		
			45.5 ^a 12.5		Ref 15 (a) 2.8×10^9 Hz
			36.5 ^a 10.7		
	100.0 800	71.0 107			Ref 14

Table 6 (contd)

Meat

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Beef (raw) (contd)	5	ϵ' ϵ''					
	2	ϵ' ϵ''					
	-10	ϵ' ϵ''					
(raw)	-10	ϵ' ϵ''					
(raw)	5	ϵ' ϵ''					
	30	ϵ' ϵ''					
	65	ϵ' ϵ''					
	5	ϵ' ϵ''					
(cooked)	30	ϵ' ϵ''					
	65	ϵ' ϵ''					
	-20	ϵ' ϵ''					

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
	98.0 774	71.0 98.0			Ref 14 (contd)
	95.0 713	70.0 87.5			
	20.0 37.5	12.0 7.5			
	12.5 15.6	8.8 3.3			
		a 47.6	56.9 b 20.3	52.8 c 19.8	Ref 235 (a) 3×10^8 Hz ₉ (b) 0.915×10^9 Hz (c) 0.245×10^{10} Hz mc = 74.1% .
		a 77.0	54.4 b 25.1	51.3 c 17.1	
		a 112.3	50.8 b 33.7	49.0 c 18.2	
		37.9 a 23.5	33.6 b 12.3	29.2 c 10.7	Ref 235 mc = 63.9%
		38.5 a 46.0	35.4 b 16.0	30.5 c 9.6	
		35.9 a 57.8	32.1 b 19.8	27.2 c 9.6	
			5.3 a 0.66		
					Ref 15 (a) 2.8×10^9 Hz

Table 6 (contd)

Meat

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Beef (cooked) (contd) (ground)	-10	ϵ'					
		ϵ''					
	5	ϵ'					
		ϵ''					
	20	ϵ'					
		ϵ''					
	40	ϵ'					
		ϵ''					
	60	ϵ'					
		ϵ''					
	1	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
	25	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
	80	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
			6.1 ^a 0.98		Ref 15 (contd) (a) 2.8×10^9 Hz
			35.4 ^a 13.7		
			35.4 ^a 11.6		
			33.9 ^a 10.7		
			32.1 ^a 10.6		
			^a 1.64		Ref 239 (a) 0.915×10^9 Hz mc = 20% _____
			^a 13.9		mc = 45% _____
			^a 2.05		mc = 20% _____
			^a 17.8		mc = 45% _____
			^a 3.3		mc = 20% _____
			^a 29.3		mc = 45%

Table 6 (contd)

Meat

Product	T (°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Chicken (breast) (thighs)	-20	ε'					
		ε''					
	-40	ε'					
		ε''					
	-20	ε'					
		ε''					
	-40	ε'					
		ε''					
Ham (lean) (fat)	20	ε'					
		ε''					
	20	ε'					
		ε''					
Ham (precooked)	-20	ε'					
		ε''					
	-10	ε'					
		ε''					
	3	ε'					
		ε''					
	20	ε'					
		ε''					
	40	ε'					
		ε''					

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
		5.3 ^a 1.31	4.6 ^b 0.87	4.0 ^c 0.51	Ref 123 (a) 3×10^8 Hz ₉ (b) 0.915×10^{10} Hz (c) 0.245×10^{10} Hz
		4.0 ^a 0.40	3.7 ^b 0.22	3.5 ^c 0.15	
		5.4 ^a 1.10	4.7 ^b 0.54	3.9 ^c 0.54	
		4.0 ^a 0.40	3.7 ^b 0.22	3.5 ^c 0.15	
4.49×10^4	3.6×10^3	89.9			Ref 67 (a) 5×10^8 Hz
^b 1.26	180				
			6.8 ^a 1.6		Ref 15 (a) 2.8×10^9 Hz
			10.0 ^a 3.9		
			44.3 ^a 22.4		
			42.9 ^a 22.8		
			48.0 ^a 29.0		

Table 6 (contd)

Meat

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Ham (precooked) (contd)	60	ϵ'					
		ϵ''					
Pork	20	ϵ'					
		ϵ''					
	40	ϵ'					
		ϵ''					
	60	ϵ'					
		ϵ''					
	80	ϵ'					
		ϵ''					
	2	ϵ'					
		ϵ''					
	0	ϵ'					
		ϵ''					
	20	ϵ'					
		ϵ''					
	40	ϵ'					
		ϵ''					
	60	ϵ'					
		ϵ''					
	2	ϵ'					
		ϵ''					

f(Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
			49.3 ^a 32.3		Ref 15 (cont'd) (a) 2.8 x 10 ⁹ Hz
	960 8.20	700 350			Ref 6
	1.06x10 ³ 1.06				
	1.15x10 ³ 1.4				
	1.18x10 ³ 1.5				
	95.0 655	70.0 84.0			Ref 2, 15
			47.3 ^a 17.5		Ref 15 (a) 2.8 x 10 ⁹ Hz salt = 0% large variation with salt content up to 6.1%
			53.2 ^a 15.7		
			52.2 ^a 15.1		
			47.6 ^a 14.9		
	90.0 630	70.0 80.0			Ref 14

Table 6 (contd)

Meat

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Pork (contd)	-10	ε'					
		ε''					
	-20	ε'					
		ε''					
	-40	ε'					
		ε''					
(ground)	-15	ε'					
		ε''					
(cooked)	35	ε'					
		ε''					
Turkey (roll)	-20	ε'					
		ε''					
	-40	ε'					
		ε''					
Turkey (raw)	5	ε'					
		ε''					
	30	ε'					
		ε''					
	65	ε'					
		ε''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
	11.2 11.2	7.0 0.22			Ref 14 (contd)
		5.5 ^a 1.14	4.4 ^b 0.63	4.0 ^c 0.56	Ref 123 (a) 3×10^8 Hz ₉ (b) 0.915×10^9 Hz (c) 0.245×10^{10} Hz
		4.0 ^a 0.29	3.6 ^b 0.15	3.5 ^c 0.13	
			6.8 8.16		Ref 118
			23.0 55.2		
		5.3 ^a 1.21	4.5 ^b 0.73	4.1 ^c 0.61	Ref 123 (a) 3×10^8 Hz ₉ (b) 0.915×10^9 Hz (c) 0.245×10^{10} Hz
		3.8 ^a 0.29	3.6 ^b 0.17	3.5 ^c 0.13	
		66.7 ^a 57.8	60.0 ^b 26.2	52.8 ^c 21.4	Ref 235 (a) 3×10^8 Hz ₉ (b) 0.915×10^9 Hz (c) 0.245×10^{10} Hz mc = 73.8%
		65.6 ^a 103.7	59.0 ^b 38.5	53.3 ^c 21.4	
		63.1 ^a 160.4	56.9 ^b 52.4	50.8 ^c 26.2	

Table 6 (contd)

Meat

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Turkey (cooked) (contd)	5	ε'					
		ε''					
	30	ε'					
		ε''					
	65	ε'					
		ε''					

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
		46.7 ^a	41.3 ^b	37.9 ^c	Ref 235 (contd) (a) 3×10^8 Hz ₉ (b) 0.915×10^9 Hz (c) 0.245×10^{10} Hz mc = 66.5%
		46.0	19.3	16.0	
		45.6 ^a	38.5 ^b	39.0 ^c	
		78.1	28.9	16.0	
		37.4 ^a	37.4 ^b	33.9 ^c	
		88.8	36.4	16.0	

Table 7

Oils and Fats

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Bacon fat	25	ϵ'					
		ϵ''					
	49	ϵ'					
		ϵ''					
	82	ϵ'					
		ϵ''					
	-20	ϵ'					
		ϵ''					
Beef fat	-20	ϵ'					5.2
		ϵ''					1.72
	0	ϵ'					
		ϵ''					
	20	ϵ'					
		ϵ''					
	10	ϵ'					
		ϵ''					
	5	ϵ'					
		ϵ''					
	0	ϵ'					
		ϵ''					
	-5	ϵ'					
		ϵ''					

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
		2.75 ^a 0.172	2.62 0.163	2.50 ^b 0.133	Ref 170 (a) 3×10^8 Hz (b) 3×10^9 Hz
		2.80 ^a 0.149	2.66 0.161	2.54 ^b 0.152	
		2.77 ^a 0.099	2.64 0.144	2.53 ^b 0.148	
3.5 ^b 0.560	3.0 ^c 0.210				Ref 41 (a) 2×10^5 Hz (b) 2×10^6 Hz (c) 2×10^7 Hz
12.0 ^b 8.16	7.0 ^c 3.5				
	7.0 ^c 5.25				
	10.8 15.7	5.9 3.0			Ref 14
	10.5 14.7	5.9 2.9			
	9.4 12.2	5.5 2.4			
	4.8 3.12	3.5 0.7			

Table 7 (contd)

Oils and Fats

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Beef fat (contd) (clarified)	-10	ϵ'					
		ϵ''					
	-20	ϵ'					3.0 ^a
		ϵ''					0.183
	0	ϵ'					3.5 ^a
		ϵ''					0.333
	20	ϵ'					3.9 ^a
		ϵ''					0.191
	40	ϵ'					3.7 ^a
		ϵ''					0.122
	70	ϵ'					3.9 ^a
		ϵ''					0.312
Castor oil		ϵ'					4.86
		ϵ''					0.041
Coconut oil		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
Corn oil	25	ϵ'					
		ϵ''					
	49	ϵ'					
		ϵ''					

f(Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
	4.0	3.0			Ref 41 (contd) (a) 2 x 10 ⁵ Hz (b) 2 x 10 ⁶ Hz (c) 2 x 10 ⁷ Hz
	1.6	0.42			
2.9 ^b	3.0 ^c				Ref 41 (a) 2 x 10 ⁵ Hz (b) 2 x 10 ⁶ Hz (c) 2 x 10 ⁷ Hz
0.131	0.099				
3.0 ^b	2.9 ^c				
0.252	0.180				
3.7 ^b	3.2 ^c				
0.148	0.186				
3.6 ^b	3.4 ^c				Ref 208
0.054	0.109				
3.9 ^b	3.6 ^c				
0.062	0.119				
4.79	4.50				
0.133	0.305				
	3.44 ^a				Ref 129 (a) 1.5 x 10 ⁷ Hz
	4.50 ^a				
		2.83 ^a	2.64	2.53 ^b	Ref 170 (a) 3 x 10 ⁸ Hz (b) 3 x 10 ⁹ Hz
		0.174	0.175	0.143	
		2.87 ^a	2.70	2.57 ^b	
		0.134	0.174	0.166	

Table 7 (contd)

Oils and Fats

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Corn oil (contd)	82	ϵ'					
		ϵ''					
Cottonseed	25	ϵ'					
		ϵ''					
	49	ϵ'					
		ϵ''					
	82	ϵ'					
		ϵ''					
Ham fat	20	ϵ'					
		ϵ''					
Lard	25	ϵ'					
		ϵ''					
	49	ϵ'					
		ϵ''					
	82	ϵ'					
		ϵ''					
Linseed oil		ϵ'					3.43
		ϵ''					
Mustard oil		ϵ'					3.12
		ϵ''					0.069
Olive oil		ϵ'					3.18
		ϵ''					0.018

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
		2.86 ^a 0.103	2.71 0.146	2.59 ^b 0.163	Ref 170 (cgntd) (a) 3×10^8 Hz (b) 3×10^9 Hz
		2.83 ^a 0.171	2.86 0.174	2.83 ^b 0.143	
		2.63 ^a 0.132	2.67 0.171	2.67 ^b 0.165	
		2.52 ^a 0.103	2.54 0.146	2.55 ^b 0.160	
1.26×10^3	180				Ref 67
		2.72 ^a 0.153	2.58 0.158	2.49 ^b 0.127	Ref 170 (a) 3×10^8 Hz (b) 3×10^9 Hz
		2.78 ^a 0.137	2.65 0.159	2.53 ^b 0.154	
		2.77 ^a 0.109	2.66 0.137	2.54 ^b 0.148	
3.36 0.022	3.33 0.063				Ref 208
3.12 0.092	3.09 0.093				Ref 208
3.17 0.039	3.11 0.076				Ref 208

Table 7 (contd)

Oils and Fats

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Pork fat	10	ϵ'					
		ϵ''					
	-5	ϵ'					
		ϵ''					
	0	ϵ'					
		ϵ''					
	-5	ϵ'					
		ϵ''					
	-10	ϵ'					
		ϵ''					
	20	ϵ'					2.25
		ϵ''					0.185
	30	ϵ'					2.38
		ϵ''					0.176
	40	ϵ'					2.38
		ϵ''					0.033
	50	ϵ'					2.28
		ϵ''					0.011
	60	ϵ'					2.21
		ϵ''					0.019
	70	ϵ'					2.18
		ϵ''					0.011
	80	ϵ'					2.14
		ϵ''					0.068

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
	12.4 12.4	6.6 2.8			Ref 14
	12.3 12.3	6.5 2.6			
	11.0 9.9	6.3 2.2			Ref 14
	5.4 1.7	4.2 0.8			
	4.5 1.1	3.7 0.4			
	2.12 0.053				
	2.20 0.015				
	2.24 0.039				
	2.19 0.069				Ref 59
	2.17 0.042				
	2.14 0.035				
	2.13 0.030				

Table 7 (contd)

Oils and Fats

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Pork fat (contd)	80	ϵ'					2.14
		ϵ''					0.068
	90	ϵ'					2.13
		ϵ''					0.048
	20	ϵ'					2.30
		ϵ''					0.046
	40	ϵ'					2.43
		ϵ''					0.036
	60	ϵ'					2.27
		ϵ''					0.034
	80	ϵ'					2.19
		ϵ''					0.028
Pork fat (clarified)	20	ϵ'					
		ϵ''					
	-20	ϵ'					2.7 ^a
		ϵ''					0.111
	0	ϵ'					3.1 ^a
		ϵ''					0.112
	20	ϵ'					3.3 ^a
		ϵ''					0.056
	40	ϵ'					3.3 ^a
		ϵ''					0.008

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
	2.13 0.030				Ref 59 (contd)
	2.13 0.027				
	2.20 0.154				Ref 4
	2.29 0.046				
	2.2 0.02				
	2.19 0.055				
			57 ^a		Ref 15 (a) 2.8×10^9 Hz
2.6 ^b 0.099	2.9 ^c 0.078				Ref 41 (a) 2×10^5 Hz (b) 2×10^6 Hz (c) 2×10^7 Hz
3.0 ^b 0.111	3.1 ^c 0.149				
3.1 ^b 0.059	3.2 ^c 0.122				
3.2 ^b 0.019	3.3 ^c 0.092				

Table 7 (contd)

Oils and Fats

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Pork fat (clarified) (contd)	70	ϵ'					3.3 ^a
		ϵ''					0.03
	100	ϵ'					3.4 ^a
		ϵ''					0.612
Sesame oil		ϵ'					3.31
		ϵ''					0.011
Soybean salad oil	25	ϵ'					
		ϵ''					
	49	ϵ'					
		ϵ''					
	82	ϵ'					
		ϵ''					
Sunflower oil	25	ϵ'					
		ϵ''					
	75	ϵ'					
		ϵ''					
	125	ϵ'					
		ϵ''					
	175	ϵ'					
		ϵ''					
	225	ϵ'					
		ϵ''					

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
3.2 ^b	3.4 ^c				Ref 41 (contd) (a) 2×10^5 Hz (b) 2×10^6 Hz (c) 2×10^7 Hz
0.016	0.061				
3.3 ^b	3.3 ^c				
0.158	0.083				
3.28	3.22				Ref 208
0.020	0.083				
		2.853 ^a	2.612	2.506 ^b	Ref 170 (a) 3×10^8 Hz (b) 3×10^9 Hz
		0.159	0.168	0.138	
		2.879 ^a	2.705	2.590 ^b	
		0.138	0.174	0.168	
		2.862 ^a	2.715	2.594 ^b	
		0.092	0.140	0.160	
			2.49 ^a		Ref 4 (a) 2.2×10^9 Hz Temperature increasing
			0.18		
			2.56 ^a		
			0.185		
			2.58 ^a		
			0.155		
			2.50 ^a		
			0.132		
			2.46 ^a		
			0.116		

Table 8

Sugars

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Glucose	20	ϵ'					
		ϵ''			0-0.05	0-0.05	0-0.1
	5	ϵ'					
		ϵ''					
	25	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
	30	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
	50	ϵ'					
		ϵ''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
0-0.13	0-0.13	0-0.13			Ref 1 0% water
		75.9 2.3	68.0 16.0	25.5 23.5	Ref 224 2.8 m solution
			73.9 6.5		Ref 198 20% glucose solution
			63.1 10.6		40%
			44.6 13.9		60%
			65.9 ^a 13.3	48.6 ^b 28.9	Ref 90 (a) 3.05×10^9 Hz (b) 1.15×10^{10} Hz 20% glucose solution
				46.5 ^b 26.8	30%
			53.6 ^a 17.6	33.1 ^b 20.4	40%
				23.1 ^b 16.8	50%
			35.8 ^a 17.2		60%
			64.3 ^a 8.8	50.8 ^b 21.0	Ref 90 (a) 3.05×10^9 Hz (b) 1.15×10^{10} Hz 20% glucose solution

Table 8 (contd)

Sugars

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Glucose (contd)	50	ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
	70	ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
Maltose	20	ε'					
		ε''			0-0.1	0-0.1	0-0.2
	5	ε'					
		ε''					

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
				49.1 ^b 21.6	Ref 90 (contd) (a) 3.05 x 10 ⁹ Hz (b) 1.15 x 10 ¹⁰ Hz 30% glucose solution
			55.5 ^a 13.8	34.7 ^b 18.4	40%
				31.9 ^b 17.5	50%
			39.9 ^a 15.0	21.3 ^b 13.7	60%
			59.3 ^a 5.9	52.5 ^b 14.7	20%
				48.3 ^b 16.5	30%
			52.9 ^a 8.2	41.1 ^b 17.2	40%
				35.2 ^b 16.1	50%
			45.5 ^a 11.8	24.9 ^b 13.0	60%
0-0.3	0-0.3	0-0.2	0-0.15	0-0.1	Ref 1 0% water
		75.3 2.5	67.0 15.5	24.5 26.5	Ref 224 1.4 m solution

Table 8 (contd)

Sugars

Product	T(°C)	—					
			10	10 ²	10 ³	10 ⁴	10 ⁵
Ribose	5	ε'					78.2 ^a
		ε''					0
Sucrose	5	ε'					
		ε''					
	25	ε'					
		ε''					
		ε'					
		ε''					
	30	ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
	50	ε'					
		ε''					
		ε'					
		ε''					

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
78.2	78.2	78.0	72.0	24.0	Ref 224
0	0	1.5	13.5	27.0	2.8 m solution (a) 2 x 10 ⁵ Hz
		76.5 ^a	59.0 ^b	24.0	Ref 224
		4.5	21.4	24.5	2.8 m solution (a) 2 x 10 ⁸ Hz (b) 2 x 10 ⁹ Hz
			72.3		Ref 198
			6.8		20% sucrose solution
			61.5		_____
			10.6		40%
			43.1		_____
			14.5		60%
			64.5 ^a	46.7 ^b	Ref 90
			13.5	23.8	(a) 3.05 x 10 ⁹ Hz (b) 1.15 x 10 ¹⁰ Hz 20% sucrose solution
				41.8	_____
				24.2	30%
			49.1	29.5	_____
			16.4	19.4	40%
			28.5 ^a	15.4 ^b	_____
			15.7	11.0	60%
			63.1 ^a	49.4 ^b	_____
			9.4	18.2	20%
				44.0 ^b	_____
				19.1	30%

Table 8 (contd)

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Sucrose (contd)	50	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
	70	ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					
		ϵ'					
		ϵ''					

f (Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
			51.7 ^a 11.8	38.0 ^b 17.7	Ref 90 (contd) (a) 3.05×10^9 Hz (b) 1.15×10^{10} Hz 40% sucrose solution
			34.4 ^a 14.4	17.9 ^b 11.6	60% _____
				12.4 ^b 8.1	72% _____
			59.8 ^a 6.5	48.9 ^b 16.3	20% _____
				45.4 ^b 14.5	30% _____
			51.2 ^a 8.8	38.2 ^b 16.3	40% _____
			38.4 ^a 11.3	24.0 ^b 14.4	60% _____
				15.8 ^b 11.3	72% _____

Table 9

Vegetables

Product	T(°C)	—					
			10	10 ²	10 ³	10 ⁴	10 ⁵
Cabbage	20	ε'					
		ε''					
		ε'					
		ε''					
Carrot (raw)		ε'					
		ε''			4.7x10 ⁵	5.4x10 ⁴	9.3x10 ³
Carrot (cooked)	20	ε'					
		ε''					
	-10	ε'					
		ε''					
	3	ε'					
		ε''					
	40	ε'					
		ε''					
	60	ε'					
		ε''					
	-20	ε'					
		ε''					
	22	ε'					
		ε''					
Carrot (raw)	22	ε'					
		ε''					
Carrot (dehydrated)	20.7	ε'				2.4	2.3
		ε''					0.029

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
	4.0 0.144				Ref 67 mc = 3% _____
	5.0 0.165				
5.4×10^3	1.4×10^3				Ref 209
			71.5 ^a 17.9		Ref 15 (a) 2.8×10^9 Hz Ref 16
			5.5 ^a 0.35		
			75.6 ^a 25.4		
			66.8 ^a 15.4		
			60.6 ^a 15.0		
			4.2 ^a 0.34		
		73.3 118	67.7 17.8		Ref 236
2.3 0.050					Ref 40 dry basis mc = 1.5%

Table 9 (contd)

Vegetables

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Carrot (dehydrated) (contd)	20.77	ε'				2.6	2.5
		ε''					0.029
		ε'				2.8	2.7
		ε''					0.111
		ε'				4.05	3.48
		ε''					0.475
		ε'				16.43	8.97
		ε''					15.72
		ε'				22.54	12.5
		ε''					49.8
Peas (cooked)	-20	ε'					
		ε''					
	-10	ε'					
		ε''					
	3	ε'					
		ε''					
	20	ε'					
		ε''					
	40	ε'					
		ε''					
	60	ε'					
		ε''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
2.5 0.076					Ref 40 (contd) dry basis mc = 3.8% <hr/> mc = 6.1% <hr/> mc = 8.5% <hr/> mc = 16.3% <hr/> mc = 18.7%
2.7 0.112					
3.23 0.311					
6.37 3.36					
8.35 7.48					
			4.1 ^a 0.29		Ref 15 (a) 2.8×10^9 Hz
			4.4 ^a 0.45		
			64.3 ^a 22.0		
			63.2 ^a 15.8		
			58.9 ^a 13.8		
			53.0 ^a 12.1		

Table 9 (contd)

Vegetables

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Peas (raw)	21	ϵ'			1.72	1.4	
		ϵ''			0.002	0.014	
Peas (boiled)	-15	ϵ'					
		ϵ''					
	23	ϵ'					
		ϵ''					
Potato (mashed) (mashed)	30	ϵ'					
		ϵ''					
	40	ϵ'					
		ϵ''					
	50	ϵ'					
		ϵ''					
	20	ϵ'					
		ϵ''					
	-20	ϵ'					
		ϵ''					
	-10	ϵ'					
		ϵ''					
	3	ϵ'					
		ϵ''					
	20	ϵ'					
		ϵ''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
					Ref 60
			2.5 0.5		Ref 118
			9.0 4.5		
			72.5 ^a 24.0		Ref 4 (a) 2.2×10^9 Hz
			72.0 ^a 24.5		
			72.5 ^a 28.0		
			65.5 ^a 22.0		Ref 15 (a) 2.8×10^9 Hz
			^b 0	4.6 ^c 0.32	Ref 17, 15 (a) 4.5×10^8 Hz (b) 9×10^8 Hz (c) 2.7×10^8 Hz
			^b 1.0		
		^a 46	^b 22.0	66.7 ^c 25.5	
		^a 65	^b 25.0	64.6 ^c 21.7	

Table 9 (contd)

Vegetables

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Potato (mashed) (contd)	40	ε'					
		ε''					
	60	ε'					
		ε''					
Potato (raw)	25	ε'					
		ε''			8.3x10 ⁵	9.2x10 ⁴	2.0x10 ⁴
	25	ε'				9.8x10 ⁴	
		ε''				6.7x10 ⁵	
	22	ε'					
		ε''					
	20	ε'					
		ε''					
	25	ε'					
		ε''					
(dried)	25	ε'					
		ε''					
		ε'					
		ε''					
	20	ε'					
		ε''					
		ε'					
		ε''					

f(Hz)					
10^6	10^7	10^8	10^9	10^{10}	Remarks
	a	b			Ref 17, 15 (contd) (a) 4.5×10^8 Hz (b) 9×10^8 Hz (c) 2.7×10^8 Hz
	89	30			
	a	b			
	110	38			
9×10^3	1.4×10^3				Ref 209
3.0×10^4					Ref 2
2.2×10^4					
	75	65			Ref 236
	208	28.8			
				43	Ref 39
				26.7	
		80.0 a	65.1	57.3 b	Ref 169 (a) 3×10^8 Hz (b) 3×10^9 Hz mc = 79.5%
		47.8	19.6	15.7	
		82.6 a	74.7	69.1 b	Ref 169 (a) 3×10^8 Hz (b) 3×10^9 Hz mc = 83.3%
		60.9	26.1	17.0	
		77.4 a	70.3	62.9 b	_____ mc = 81.2%
		58.5	24.8	17.2	
	5.5				Ref 67
	0.325				
	6.0				_____ mc = 13%
	0.560				

Table 9 (contd)

Vegetables

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Potato (freeze dried) (contd) (boiled)	25	ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
		ε'					
		ε''					
	-15	ε'					
		ε''					
	23	ε'					
		ε''					
Potato chips (crisps)	25	ε'					
		ε''					
	50	ε'					
		ε''					
	81	ε'					
		ε''					
	21.5	ε'					
		ε''					
	50	ε'					
		ε''					

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
			5.0 ^a 0		Ref 124 (a) 3.0 x 10 ⁹ Hz mc = 10% _____ mc = 20% _____ mc = 50% _____ mc = 80%
			7.8 ^a 2.2		
			41.7 ^a 20.6		
			62.8 ^a 17.8		
			4.5 0.9		Ref 118
			38 11.4		
			5.76 2.06	5.18 ^a 2.85	Ref 169 (a) 3 x 10 ⁹ Hz mc = 15.3%
			6.74 2.52	5.74 ^a 3.78	
			7.30 3.10	6.48 ^a 4.66	
			1.89 0.065	1.86 ^a 0.068	
			1.89 0.077	1.86 ^a 0.082	mc = 2.6%

Table 9 (contd)

Vegetables

Product	T(°C)						
			10	10 ²	10 ³	10 ⁴	10 ⁵
Potato chips (crisps) (contd)	80	ϵ'					
		ϵ''					
Spinach	-15	ϵ'					
		ϵ''					
	23	ϵ'					
		ϵ''					
Squash	-15	ϵ'					
		ϵ''					
	23	ϵ'					
		ϵ''					

f (Hz)					
10 ⁶	10 ⁷	10 ⁸	10 ⁹	10 ¹⁰	Remarks
			1.98 0.090	1.91 ^a 0.098	Ref 169 (contd) (a) 3 x 10 ⁹ Hz
			13.0 6.5		Ref 118
			34.0 27.2		
			5.0 1.5		Ref 118
			47.0 37.6		



